Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Use of Spectrum Bands Above 24 GHz For Mobile Radio Services	)	GN Docket No. 14-177
	)	
Establishing a More Flexible Framework to Facilitate Satellite Operations in the 27.5-28.35 GHz and 37.5-40 GHz Bands	)	IB Docket No. 15-256
	)	
Petition for Rulemaking of the Fixed Wireless Communications Coalition to Create Service Rules for the 42-43.5 GHz Band	)	RM-11664
	)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95, and 101 To Establish Uniform License Renewal, Discontinuance of Operation, and Geographic Partitioning and Spectrum Disaggregation Rules and Policies for Certain Wireless Radio Services	)	WT Docket No. 10-112
	)	
Allocation and Designation of Spectrum for Fixed-Satellite Services in the 37.5-38.5 GHz, 40.5-41.5 GHz and 48.2-50.2 GHz Frequency Bands; Allocation of Spectrum to Upgrade Fixed and Mobile Allocations in the 40.5-42.5 GHz Frequency Band; Allocation of Spectrum in the 46.9-47.0 GHz Frequency Band for Wireless Services; and Allocation of Spectrum in the 37.0-38.0 GHz and 40.0-40.5 GHz for Government Operations	)	IB Docket No. 97-95

INTEL CORPORATION OPPOSITION COMMENTS TO PETITIONS FOR RECONSIDERATION

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I. Introduction and summary

Intel Corporation ("Intel") respectfully submits these comments expressing opposition to certain petitions for reconsideration of the Commission's Report and Order[1] on the use of spectrum bands above 24 GHz for mobile radio services. Our comments address petitions related to technical rules and authorization status of millimeter wave (mmW) spectrum bands. Intel is a leader in designing and building the essential technologies that serve as the foundation for the world's computing and communications devices.

Intel reiterates its strong support of the Commission's leadership in opening the first phase of millimeter wave spectrum (the 28 GHz, 37 GHz, and 39 GHz exclusive licensed bands for mobile use such as 5G, and the 64-71 GHz band for unlicensed use), as well as the second phase of mmW spectrum contemplated via the *Further Notice*. The Commission's expedited actions in developing its rules are promoting U.S. leadership in millimeter wave 5G by providing the marketplace with flexible-use spectrum for enabling terrestrial mobile 5G as well as unlicensed use.

Some petitioners seek to reverse the Commission's action to authorize the 64-71 GHz band for Part 15 unlicensed use, with two of the petitioners proposing that 5 GHz of that 7 GHz range should be reassigned for licensed use in order to create better balance. Intel believes, as does the Commission and the majority of commenters on this matter, that the case made in the comment record for unlicensed use of 64-71 GHz was stronger than the alternative. Petitioners reiterated points already fully considered by the Commission in reaching its decision. The petitioners do not raise any relevant new

[1] *Use of Spectrum Bands Above 24 GHz For Mobile Radio Services*, *et al*., Report and Order and Further Notice of Proposed Rulemaking, GN Docket No. 14-177, Released July 14, 2016 ("*Report and Order*" or "*Further Notice*" as applicable).

facts or analysis to justify reconsideration, and the authorization of the 64-71 GHz band should be maintained as a Part 15 unlicensed band.

Certain petitions from the satellite industry seek to impose additional and unnecessary requirements on terrestrial systems, or seek outcomes more favorable to them than the well-reasoned decisions reached by the Commission. These petitioners either incorrectly characterize their positions as addressing a Commission oversight, or simply seek reconsideration of settled matters without providing any relevant new information or analysis.

More specifically, satellite petitioners seek: reversal of FSS secondary status and the imposition of aggregate interference rules in the 28 GHz band; unnecessary mandates on operational requirements for beamforming, power control, and total radiated power; an unnecessary ban on omnidirectional antennas; and unnecessary reductions in maximum EIRP. Each of these petitions qualifies for dismissal or denial under the rules for reconsideration petitions.

Intel agrees with the petitions seeking clarification that the 37-40 GHz band-wide operability requirement should exclude any impact specific to the yet-to-be-resolved sharing requirements. This clarification is important so that the development of products for the non-shared portions of the band are not held up while awaiting the completion of the lengthy future process to develop the sharing rules, and the unpredictable operability impact thereof. As TIA notes in its petition, the clarification can be achieve in one sentence, stating that any mobile or transportable device will meet the operability requirement as long as it can be *tuned* across this band on each air interface it uses to operate in the band. This may have been the intent of the Commission's requirement to begin with, but the current language lacks specificity and can be easily remedied.

II. The entire 64-71 GHz band should retain its status as a Part 15 unlicensed band.

Three petitioners (CTIA, T-Mobile, and the Competitive Carriers Association (CCA))[2] suggest that the Commission inappropriately allocated the 64-71 GHz band entirely for unlicensed Part 15 use. Upon reviewing these petitions, Intel does not find that the 64-71 GHz petitioners meet the requirement for presenting "facts or arguments which have not previously been presented to the Commission,"[3] and the 64-71 GHz reconsideration petitions should not be granted. A common theme in the three petitions was that the Commission should have allocated nearly equal amounts of licensed and unlicensed spectrum during the first phase of the mmW proceeding (the Commission comprehended and rejected this notion of arbitrarily creating "GHz parity" between unlicensed and licensed use).[4]

It is also important to note that in the second phase of this mmW proceeding (currently under consideration via the *Further Notice*),[5] *up to 17.7 GHz would be made available for licensed use*, with an unknown but certainly smaller amount (potentially zero) made available for unlicensed Part 15 use. When aggregated across the two phases of this mmW proceeding, rather than viewing the first phase in isolation as petitioners are doing, the perceived imbalance in favor of unlicensed spectrum ceases to exist. In other words, petitioners' arguments about imbalance are fundamentally time-limited; even under the best-case interpretation it is a temporarily relevant point that resolves itself.

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[2] *See* GN Docket No. 14-177, Petitions for Reconsideration filed by: CTIA, posted Dec 15, 2016; T-Mobile, posted Dec 15, 2016; Competitive Carriers Association, posted Dec 15, 2016. ("*64-71 GHz petitioners*").
[3] 47 C.F.R §1.429(b).
[4] Report and Order ¶129.
[5] GN Docket No. 14-177, "Use of Spectrum Bands Above 24 GHz for Mobile Radio Services," Report and Order and Further Notice of Proposed Rulemaking, released July 14, 2016.

CCA suggests that the Commission "allocated far less 5G spectrum than expected for exclusively licensed use," which amounted to "almost twice the amount of unlicensed spectrum as licensed," and concluding the Commission "should more evenly allocate the 64-71 GHz band [by] allocating as little as 5 GHz for licensed mobile use."[6] In its NPRM, the Commission put forth its tentative conclusion that unlicensed Part 15 use of the 64-71 GHz band "is the better approach in this band" compared to licensed use.[7] This NPRM action was based on strong support in the NOI phase,[8] and further reinforced in the NPRM comment record. None of the points raised by CCA were unknown to the Commission, and no new points were raised; the arguments "have been fully considered and rejected."[9] The question of balance, or equality, is common to the three petitions and will be addressed collectively below, in our discussion of CTIA's petition.

Similarly, T-Mobile suggests that this decision is "making unlicensed spectrum available at the expense of licensed use."[10] T-Mobile also points out that, "only a small amount of the 3.25 gigahertz of spectrum designated for exclusive licensed use will actually be auctioned, as most is already licensed to incumbent entities." CCA also raises this point.[11] While this point was also known to and considered by the Commission at the time of its decision, new information has become available wherein the largest incumbent spectrum holder in the 39 GHz band will be relinquishing its licenses within a year.[12] Thus,

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[6] CCA petition at 8.
[7] NPRM ¶58.
[8] NPRM ¶302, referring to the mmW NOI comment record, "Commenters unanimously support this action and recommend that the Commission proceed with extending the band to cover 57 to 71 GHz under the same Part 15 provisions that allow operation in the currently authorized 57-64 GHz band."
[9] 47 C.F.R §1.429(l).
[10] T-Mobile petition at 4.
[11] CCA petition at 8.
[12] *See* Straight Path Enforcement Order, released Jan 12, 2017, available at: http://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0112/DA-17-40A1.pdf

this particular point now weighs even less as a component of the overall decision than it did at the time of the decision.

CTIA, in its petition, claims that allocating this band "solely for unlicensed uses is unsupported by the record evidence."[13] In fact, there was a robust record of nearly two dozen commenters on this issue, with more than twice as many commenting in support of unlicensed use for the 64-71 GHz band.[14] While spectrum proceedings are not intended to be decided by popular vote, in this case the supporters of unlicensed use of the 64-71 GHz band made a sustained, stronger, and more complete case than supporters of licensed use, and also outnumbered them.[15] Thus, the public interest argument was more compelling for unlicensed use of this band.

CTIA's petition on this matter also asserts a lack of evidence that unlicensed devices would use the band in the near future, and a mischaracterization of product development, citing "only five products have been certified by the Wi-Fi Alliance."[16] While "only five" certifications at such an early stage of the mmW market development would arguably be an impressive statistic, certification listings by the Wi-Fi Alliance can represent product *families,* consisting of multiple products. Setting aside that point, a more complete representation of product development activity for the existing 57-64 GHz

[13] CTIA petition at 20.
[14] mmW NPRM Commenters in favor of unlicensed use for the 64-71 GHz band were: Boeing at 11, Consumer Technology Association at 8, Dynamic Spectrum Alliance at 2, Facebook at 5, Fixed Wireless Communications Coalition at 3, Google at 6, Huawei at 19, Intel at 17, Microsoft at 5, National Cable & Telecommunications Association at 3, Open Technology Institute & Public Knowledge at 27, Qualcomm at 14, Straight Path at 6, ViaSat at 21, Vubiq Networks at 3, and Wi-Fi Alliance at 5. NPRM Commenters opposed to making the full 64-71 GHz band unlicensed were: AT&T at 17, CTIA at 17, Ericsson at 19, Mobile Future at 16, Nokia at 17, T-Mobile at 15, and Verizon at 13.
[15] *See e.g.* NPRM comments of Intel, NPRM comments of Wi-Fi Alliance.
[16] CTIA petition at 20.

unlicensed band is found via the FCC's Equipment Authorization Search website,[17] where *well over one hundred device certifications have been granted,* which is impressive evidence by any measure.

Petitioners also claim a time-to-market advantage for licensed product and standards development in this band compared to unlicensed.[18] It is not clear what information could lead to that claim. As a straightforward extension of the immediately adjacent unlicensed 57-64 GHz band, both product and standards development for unlicensed use of the 64-71 GHz band can be reasonably expected to build upon prior years' efforts rather than beginning anew. Given the impressive figures we noted above for product certifications in the adjacent 57-64 GHz band, and given that products could not legally use the 64-71 GHz band until after published rules existed, there is every reason to believe that unlicensed mmW products with expanded range to cover the 64-71 GHz band will appear in a timely manner.

The approved IEEE 802.11-2016 standard already supports IEEE 802.11ad devices operating in 64-71 GHz range, and product developments to take advantage of the Commission's recent authorization of this band for unlicensed use are underway. In addition, the draft amendments to the standard, known as IEEE 802.11ay, will enable higher throughput and lower latency for 60 GHz operations. The IEEE 802.11ay draft process is well underway and a certifiable draft, which permits product introductions to take advantage of the enhancements in 802.11ay, is expected to be voted upon by the end of this year.

Finally, petitioners claim the Commission failed to quantify in a mathematically-derived sense, the disparity between licensed and unlicensed spectrum in these bands, and petitioners seek disclosure

[17] *See* https://apps.fcc.gov/oetcf/eas/reports/GenericSearch.cfm
[18] CTIA petition at 21.

of the degradation factor used by the Commission in arriving at the disparity.[19] The lack of this mathematical paper trail, according to petitioners, relegates the Commission's decision to being unjust and arbitrary.[20]

The proportion of licensed versus unlicensed spectrum is a policy choice; it is not governed by laws of physics and thus does not resolve to an answer via incontrovertible mathematical equations. Intel strongly encourages the Commission *not* to heed these calls from petitioners for arbitrary "gigahertz parity" of licensed and unlicensed spectrum in this or any other band. It would be an unwise and unsustainable precedent.

Currently there is no documented policy framework or methodology guiding the Commission's licensed versus unlicensed allocation decisions. In the absence of a more systematic approach, the decision to allocate or not allocate a band for unlicensed use has generally been based on market development factors that are partly band-specific, and partly broader-looking assessments across all bands. In our NPRM comments, Intel addressed these market factors in support of unlicensed use for the 64-71 GHz band. We noted the growing demand for WiGig applications in 57-64 GHz, the expanding bandwidth needs, and numerous usage models that have been defined and documented by the IEEE. Further, we noted the strong vendor ecosystem support for developing products, services, and standards.[21] In short, the comment record contains what would by historical comparison be considered one of the most robust upfront justifications for unlicensed usage of a particular band.

[19] CTIA petition at 22.
[20] CTIA petition at 23.
[21] NPRM comments of Intel at 17.

Collectively, these factors explain why Intel—a consistent supporter of exclusive licensed spectrum—supports unlicensed use for the particular case of the 64-71 GHz band. It also explains why a majority of commenters support unlicensed use of the band as well. In turn, it explains why the Commission was justified in its decision, based on consideration of the entirety of the extensive comment record and the more compelling public interest arguments for unlicensed use of this particular band.

Petitioners and all other opposing parties had ample opportunity to submit comparable assessments into the record relative to potential licensed use of the band. By the NPRM comment deadline, those submissions were essentially limited to noting that the ITU plans to *study* the 66-71 GHz portion of the band, and that "GHz parity" was not being met. These points were acknowledged and rejected by the Commission in the Report and Order.[22] Petitioners included additional information about experimental work in *different* mmW spectrum such as 73 GHz,[23] but that information was already known at the time of the Commission's decision, and in any case it does not represent direct relevance to the 64-71 GHz band.

In summary, on the question of reconsideration of the 64-71 GHz band, none of the petitioners present a case that meets the narrow requirements in *47 CFR 1.429(b)* for a grant of reconsideration. Instead, petitioners rely on arguments that qualify for dismissal or denial under *47 CFR 1.429(l)*.

[22] Report and Order ¶130.
[23] CTIA petition at 23; T-Mobile petition at 8.

III. Satellite petitioners seek to re-litigate a host of well-considered and settled matters.

Under the rules, petitions for reconsideration must rely "on facts or arguments which have not previously been presented to the Commission," and will be granted only if there are facts or events that were previously unknown, or changed, and the Commission determines they are required in the public interest.[24] Below we individually review specific topics proposed for reconsideration by the satellite industry, but more generally Intel believes there was a broad failure to meet the requirements for a grant of reconsideration. Instead, these petitions were a broad rehash of fully-considered and rejected arguments, which qualifies them for dismissal or denial.

A. Satellite petitioners propose unnecessary technical mandates on UMFUS operations.

Boeing seeks technical mandates to be imposed on terrestrial operations for beamforming and power control, as well as a ban on omnidirectional antennas. Boeing also seeks rule changes to reduce maximum EIRP and impose an in-band TRP (total radiated power) requirement, which are discussed separately, below. Intel does not believe any relevant new facts are presented, so the proposed reconsiderations should be denied.

While Boeing claims the Commission overlooked its concerns regarding beamforming and power control mandates,[25] this is simply a matter of long-standing Commission precedent on not being overly prescriptive, i.e. not micromanaging network operational control via its rules. In keeping with that

[24] 47 C.F.R §1.429(b).
[25] Boeing petition at 16: "the Commission…failed to consider the adoption of beamforming or power control rules."

precedent, the Commission doesn't typically itemize all the parameters it chooses *not* to regulate. Boeing does not present any scenarios where beamforming or power control would not be used, or where omnidirectional antennas would be used. The anticipated use cases for mobility in these bands include applications that require delivery of very high throughout data to users in motion. This demands high link-margin connections, which require high-gain, narrow beams following the users' motion. This is only achievable with phased array antenna systems.

The Commission did address its reluctance to impose low-level mandates of operational requirements, in the Report and Order: "given the wide variety of deployments and uses we expect to see in these bands, it would be inappropriate to universally mandate these design features [referring to beamforming, power control, and various other operational factors] in every deployment."[26] While this citation is referring to the 28 GHz band, there is no reason to believe the Commission would not use similar language for the 39 GHz band since the Commission is espousing long-standing, band-agnostic principles of restraint from dictating technology implementations.

The Fixed Satellite Service (FSS) is conditionally co-primary in 37.5-40 GHz, subject to the five conditions on deployment considerations described in the Report and Order.[27] One of those conditions is a coordination requirement with the terrestrial licensee associated with the self-defined earth station protection zone. The concerns expressed by Boeing can be readily resolved via this coordination requirement, rather than as sweeping mandates in the rules that are unnecessary and that may have future unintended consequences if implemented.

[26] Report and Order ¶67.
[27] Report and Order ¶93.

B. The Commission should decline to reconsider the settled matters of FSS having secondary status, and the unlikely potential for harmful aggregate skyward interference, in the 28 GHz band.

The arguments made by the satellite industry for co-primary status and for aggregate skyward interference protection in the 28 GHz band "have been fully considered and rejected."[28] As the Commission explained, "upgrading the FSS designation to co-primary status…would be inconsistent with terrestrial use of this band and the Commission's decision to facilitate expanded terrestrial use."[29] In light of the decision to retain secondary status, the Commission was generous in its accommodation of substantial future FSS usage opportunities, providing multiple options in its rules. Aggregate skyward interference in the 28 GHz band was also raised again by a limited number of satellite petitioners[30] as discussed below.

Under the rules, the aggregate interference argument summary in the SES/O3b petition is effectively self-disqualifying, stating "the Commission should reconsider the technical evidence satellite operators *submitted in the initial proceeding* demonstrating the risk of aggregate interference…in the 28 GHz [band]"[31] (e*mphasis added)*. The main argument in the SES/O3b petition is, "The Commission should not authorize UMFUS operations absent a mechanism to address UMFUS interference into satellites in the 28 GHz Band."[32]

The Commission fully considered the technical record, concluding that "the potential for aggregate interference rising to the level of harmful interference is unlikely and thus is not a basis for

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[28] 47 C.F.R §1.429(l).
[29] Report and Order ¶50.
[30] See SIA petition at 11 and SES/O3b petition at 19.
[31] SES/O3b petition at ii.
[32] SES/O3b petition at 20.

refusing to authorize mobile service in the 28 GHz band, and we decline to establish any regulatory limit on aggregate power levels,"[33] and further noting, "under our rules, FSS is secondary to LMDS fixed and mobile operations in the 28 GHz band" and "the Commission can, and in fact did, establish priority for mobile services through its service rules."[34] Thus, the petitioners' arguments squarely qualify for dismissal or denial under the rules governing petitions for reconsideration.

SIA, in its petition, mischaracterizes the Commission's direction to its bureaus to open a data-gathering docket dealing with aggregate interference. The SIA petition "requests that the Commission incorporate that docket into this proceeding and consider the results of that docket in the reconsideration phase of this proceeding."[35] The direction from the Report and Order is clearly intended as simply a data repository docket for submitting any future analyses; it is not a rulemaking proceeding.[36] The SIA request creates an unnecessary dependency on a non-existent requirement to develop aggregate interference rules before closure of reconsideration petitions, and should be denied.

C. Satellite petitioners seek unnecessary rule changes to UMFUS power levels.

Boeing, in its petition, seeks a reduction in the maximum base station EIRP from 75 dBm to 62 dBm, primarily arguing the 62 dBm level should be used because it was the initial proposal, and alleging extensive comment record support for it.[37] The Commission thoroughly addressed the progression of

[33] Report and Order ¶61.
[34] Report and Order ¶62.
[35] SIA petition at 11.
[36] Report and Order ¶69: "We direct the International Bureau, the Office of Engineering and Technology, and the Wireless Telecommunications Bureau to jointly establish a separate docket that parties can use to file the relevant data and analyses, and we reserve the right to revisit this issue should additional information or other circumstances warrant further Commission review or action."
[37] Boeing petition at 8.

industry analysis in arriving at the multi-party consensus of 75 dBm,[38] as well as detailing its rationale in selecting that value,[39] and directly rejected Boeing's claims while adding, "Furthermore, our rules for the 37.5-40.0 GHz band, about which Boeing expresses sharing concerns, limit the FSS to gateway-type earth station operations and prohibit the ubiquitous deployment of satellite earth stations designed to serve individual consumers."[40]

Boeing also links its EIRP reduction proposal to an additional proposal to impose a TRP (total radiated power) requirement in-band for base stations. It argues that because the OOBE (out of band emission) requirements include TRP, so too should the in-band requirements include TRP.[41] As the Commission explained in its OOBE discussion, TRP is a difficult and time-consuming measurement.[42] Furthermore, TRP is not a useful measure in-band for mmW systems, where the signal energy is spatially concentrated around the main axis, and falls off significantly when off-axis. EIRP is the most relevant in-band measure for mmW systems, and the Commission should decline Boeing's proposal to add an in-band TRP requirement, which is difficult, time-consuming, and unnecessary.

SIA, in its petition, claims there is "potential for interference into FSS satellite receivers of non-U.S. satellite networks" and in order to minimize it, proposes "that UMFUS stations be limited to a maximum transmit power level of 10 dBW (40 dBm) per station in accordance with No. 21.5 of the ITU Radio Regulations."[43] We concur with the Commission's conclusion on this matter: "We do not believe the record demonstrates that there is a risk of interference to satellites from aggregate interference

[38] Report and Order ¶¶271-273.
[39] Report and Order ¶¶276-277.
[40] Report and Order ¶278.
[41] Boeing petition at 9.
[42] Report and Order ¶303.
[43] SIA petition at 13.

caused by UMFUS stations."[44] We note the ITU Radio Regulations (RR) No. 21.5 cited by SIA is for power to the antenna (conducted power), while the FCC rules are for maximum EIRP. RR No. 1.161 defines *equivalent isotropically radiated power (EIRP) as "*The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna *(absolute or isotropic gain)*." Therefore, the U.S. rules regarding EIRP do not contravene RR No. 21.5, which does not take antenna gain into account.

It should also be noted that for the 28 GHz band, No. 21.2 and 21.3 of the RR specify a maximum EIRP of 55 dBW (85 dBm)—a higher value than the Commission's rules, which are referenced to 100 MHz bandwidth. Consequently, for all channel bandwidths below 1GHz, the Commission is already providing more protection to other services than required by the ITU Radio Regulations, and there is no justifiable reason to supplement the existing FCC rules with additional regulations. Only radiated emissions from the antenna will contribute to potential interference and the existing FCC rules not only cover that case, but do so with stricter limits than the ITU Radio Regulations. Therefore, the SIA petition for reconsideration on this matter should be denied.

IV. Conclusions

Intel believes the 64-71 GHz petitioners fail to meet the standard for reconsideration of the Commission's assignment of the 64-71 GHz band for unlicensed use. Likewise, satellite petitioners fail to meet the standard for reconsideration of the secondary status of FSS and aggregate interference topics in the 28 GHz band, as well as fail to meet the standard for reconsideration of proposed technical

[44] Report and Order ¶294.

mandates and rule changes for UMFUS systems. On the 37-40 GHz band-wide operability requirement, a statement clarifying that it excludes any impact specific to the unknown future sharing requirements within the band is justified.